PUBLIC NOTICE

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August 6, 2024

OFFICE OF INTERNATIONAL AFFAIRS SEEKS COMMENT ON RECOMMENDATIONS APPROVED BY THE WORLD RADIOCOMMUNICATION CONFERENCE ADVISORY COMMITTEE

OIA Docket No. 24-30

Comments Due: August 20, 2024

On August 5, 2024 the World Radiocommunication Conference Advisory Committee (WRC-27 Advisory Committee) approved and provided for Commission consideration of its draft recommendations on issues that will be considered by the 2027 World Radiocommunication Conference (WRC-27). Based upon an initial review of the draft recommendations forwarded to the Commission, the Office of International Affairs, in coordination with other Commission Bureaus and Offices, tentatively concludes that we can generally support most of the content found in attachment in the WRC-27 Advisory Committee draft recommendation.

We seek comment on the draft recommendations provided by the WRC-27 Advisory Committee (Attachment A). In addition, we seek comment on the National Telecommunications and Information Administration (NTIA) draft proposals in Attachment B. The comments provided by interested parties will assist the FCC in its upcoming consultations with the U.S. Department of State and NTIA in the development of U.S. positions for WRC-27. The proposed recommendations that are attached to this Public Notice may evolve in the course of interagency discussions as we approach WRC-27 and, therefore, do not constitute any final U.S. Government positions on any issue.

The deadline for comments on the proposed recommendations is August 20, 2024. It is necessary that all comments be received by August 20, 2024, in order to allow sufficient time to finalize the U.S. position before commencement of regional WRC-27 preparatory meetings.

All comments are to reference OIA Docket No. 24-30 and to specific recommendations by WAC document number. Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 CFR §§ 1.415, 1.419, interested parties may file comments on or before August 20, 2024.

Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). *See* Electronic Filing of Documents in Rulemaking Proceedings, 63 FR 24121 (1998).

- *Electronic Filers*: Comments may be filed electronically using the Internet by accessing the

ECFS: https://www.fcc.gov/ecfs/filings.

- *Paper Filers*: Parties who choose to file by paper must file an original and one copy of each filing.
    - Filings can be sent by hand or messenger delivery, by commercial courier, or by the U.S. Postal Service. All filings must be addressed to the Secretary, Office of the Secretary, Federal Communications Commission.
    - Hand-delivered or messenger-delivered paper filings for the Commission's Secretary are accepted between 8:00 a.m. and 4:00 p.m. by the FCC's mailing contractor at 9050 Junction Drive, Annapolis Junction, MD, 20701. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
    - Commercial courier deliveries (any deliveries not by the U.S. Postal Service) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
    - Filings sent by U.S. Postal Service First-Class Mail, Priority Mail, and Priority Mail Express must be sent to 45 L Street NE, Washington, DC 20554.

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In addition, one copy of each pleading must be sent to: Gregory Baker, Designated Federal Official, Global Strategy and Negotiation Division, Office of International Affairs, 45 L Street, N.E., Washington, D.C. 20554; email: WRC-27@fcc.gov. The complete texts of these recommendations are available by accessing the FCC's WRC-27 web site at: www.fcc.gov/wrc-27. For further information, please contact Gregory Baker at (202) 919-0758 or by email at: WRC-27@fcc.gov.

Attachment A

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.9: to consider appropriate regulatory actions to update Appendix **26** to the Radio Regulations in support of aeronautical mobile (OR) high frequency modernization, in accordance with Resolution **41 (WRC-23)**.

ISSUE:

The High Frequency (HF) band has been identified as an effective alternative to provide much needed integrated and interoperable Beyond-Line-of-Sight (BLOS) communications capabilities. HF is also a critical and affordable option for global broadcasting and amateur radio, and an alternative when other communications services are unavailable due to natural disasters or other national emergencies. Commercial financial institutions are exploring the use of HF long-distance delivery for financial users requiring low latency data. The challenge with meeting the growing requirement for modern HF is the need for the increased bandwidth allocations that would be required to achieve HF's advantages while not impeding the legacy frequency needs of incumbent users, groups, or countries.

There are modern wide band HF (WBHF) technologies available that enable the flexibility to use wider channel bandwidths within advanced digital HF and enhanced applications that can support a shared environment while also maximizing spectrum efficiency. Current wideband technology and methodologies are available that automate the negotiating of the Radio Frequency (RF) environment while mitigating any harmful interference to users in, or adjacent to, a desired HF frequency range.

Appendix 26 of the ITU Radio Regulations limits Aeronautical Mobile (OR) to a maximum bandwidth of 2.8 kHz.

BACKGROUND:

WRC-23 through Resolution 411 (WRC-23) resolves to invite the Radiocommunication Sector to review Appendix 26 of the Radio Regulations and consider necessary changes, as appropriate, to Appendix 26, on the basis of studies without modifying the existing area allotments, and while taking into account that the current use of the narrowband systems shall remain unchanged and shall not be impacted nor precluded by the revision of Appendix 26.

The band 3500 – 4000 kHz is allocated to the Amateur Radio Service on a primary basis in Region 2, and is allocated in the 3500 – 3800 kHz range in Region 1 and the 3500 – 3900 kHz range in Region 3. This band is intensively used for Amateur Radio operations throughout Region 2, and that use is expected to increase.

U.S. VIEW:

The U.S. supports updating Appendix 26 of the Radio Regulations to allow for the use of wider channel bandwidth in the following bands allocated to AM(OR)S as long as sharing studies show the ability of HF wideband systems to ensure compatibility with existing AM(OR)S systems and with other incumbent services in the following bands, and adjacent allocations:

- 3025 – 3155 kHz
- 3900 – 3950 kHz (Region 1 only)
- 4700 – 4750 kHz
- 5680 – 5730 kHz
- 6685 – 6765 kHz

- 8965 – 9040 kHz
- 11175 – 11275 kHz
- 13200 – 13260 kHz
- 15010 – 15100 kHz
- 17970 – 18030 kHz

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.7: to consider studies on sharing and compatibility and develop technical conditions for the use of International Mobile Telecommunications (IMT) in the frequency bands 4 400-4 800 MHz, 7 125-8 400 MHz (or parts thereof), and 14.8-15.35 GHz taking into account existing primary services operating in these, and adjacent, frequency bands, in accordance with Resolution **256 (WRC-23)**.

BACKGROUND:

The United States is actively working on the implementation of its National Spectrum Strategy (NSS), including the 7.125 – 8.4 GHz range.[1] This comprehensive strategy to modernize spectrum policy aims to make the most efficient use possible of spectrum resources for incumbent services while expanding access to advanced wireless broadband networks and technologies, whether terrestrial-, airspace-, satellite- and space-based. The drive for technological innovation is expected to boost industrial competition, ensure the adoption of secure networks, foster scientific advancements and promote digital equity and inclusion. In order to ensure spectrum resources are available to meet expected demand, the United States has identified several bands meriting in-depth study in the near term, including the 7.125 – 8.4 GHz band which will be studied for wireless broadband use (on a licensed and/or unlicensed basis, or shared-spectrum basis), though some sub-bands eventually may be studied for other uses. There are, however, a variety of mission-critical Federal operations, as well as non-Federal operations, in this band (including Fixed, Fixed Satellite, Mobile, Mobile Satellite, Space Research, Earth Exploration Satellite and Meteorological Satellite services) that will make it challenging to repurpose portions of the band while protecting incumbent users from harmful interference. A national spectrum policy that maximizes flexible use of spectrum will foster technological innovation and global leadership, reduce barriers to expanding spectrum access (especially for historically underrepresented rural communities), stimulate industry and government research, provide access to state-of-the-art technologies and services, and allow Federal agencies to pivot when new mission requirements are contemplated. Such a policy must respect current spectrum users, ensuring incumbents are protected from harmful interference and avoiding risks to national security, public safety, scientific research, or commercial operations.

Spectrum sharing opportunities are also a consideration when reallocation decisions are proposed. Whenever possible, and ideally early in the process of considering potential repurposing, prospective new users of a spectrum band to consider coexistence mechanisms that leverage technology, expertise, and knowledge of the involved parties to safeguard incumbent missions. Evolving to a "designed to share whenever feasible" mindset will accelerate efficient and effective use of spectrum for all users.

WRC-27 will consider the possibility of making available specific mid-band spectrum frequencies 4.4 – 4.8 GHz and 7.125 – 8.4 GHz, either on a regional or global basis, and the 14.8 – 15.35 GHz band, through an identification for the terrestrial component of International Mobile Telecommunications (IMT).

Today, the early vision for 6G, also known as IMT-2030, is starting to emerge as the mobile and broader vertical ecosystems embark on foundational technology research preparing for the next decade of innovations. Commercial launches are expected later in the decade.

[1] https://www.ntia.gov/issues/national-spectrum-strategy

Contiguous spectrum bandwidths other than those currently available are necessary to address growing and intensifying consumer data and ubiquitous connectivity demands. As such, discussions have already started to identify the most desirable frequency bands to address these needs. While no single frequency range satisfies all of consumers' needs, spectrum in the upper mid-band range (below 10 GHz) is well-suited to bolster current offerings and facilitate next generations of wireless technologies.

It is important to recognize that the incumbent services in the candidate bands, and adjacent bands, provide important systems for public safety, aviation, earth observation and other uses operating under the existing primary allocations, and such operations must be protected. Incumbent services did not arbitrarily select these bands for their operations—the same features which make them favorable for 5G or 6G are similarly necessary to fulfill the critical missions of incumbents. Sharing and compatibility studies are required to examine the feasibility of introducing IMT into these bands while ensuring the protection of those services to which the frequency band is allocated on a primary basis without imposing additional constraints on those services, in the same or adjacent band.

U.S. VIEW:

Alternative 1: The United States supports the sharing and compatibility studies called for in Resolution **256 (WRC-23)**, with a view to ensure the protection of services to which the frequency bands are allocated on a primary basis, including in adjacent bands, as appropriate. Based on these studies, the United States supports appropriate action at WRC-27.

Alternative 2: The United States supports the sharing and compatibility studies called for in Resolution **256 (WRC-23)**, with a view to ensure the protection of services to which the frequency bands are allocated on a primary basis, including in adjacent bands, as appropriate. The United States supports appropriate action at WRC-27 where studies demonstrate coexistence mechanisms can be employed to safeguard incumbent operations and can ensure that such an identification to IMT would not impose additional regulatory or technical constraints on those incumbent services.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.10: to consider developing power flux density and equivalent isotropically radiated power limits for inclusion in Article **21** of the Radio Regulations for the fixed-satellite, mobile-satellite and broadcasting-satellite services to protect the fixed and mobile services in the frequency bands 71-76 GHz and 81-86 GHz, in accordance with Resolution **775 (Rev.WRC-23)**.

BACKGROUND:

WRC-2000 adopted co-primary allocations in the 71-76 GHz and 81-86 GHz band for terrestrial (fixed and mobile services) and the fixed-satellite, mobile-satellite and broadcasting-satellite services. Due to technological readiness, however, administrations historically have deployed on the primary fixed service allocation in the 71-76 GHz and 81-86 GHz bands for high-capacity fixed wireless backhaul systems for point-to-point (P-P) applications. According to industry data, in the United States wireless data traffic exceeded 73.7 trillion megabytes, a 157% increase since 2018 and a 38% increase since 2021. To accommodate the growing demand for IMT services, wireless network deployments trend towards improving broadband coverage and increasing the availability of higher speeds to more subscribers. Ultimately, this translates in an increase of mobile broadband throughput and/or capacity.

As a result, new base stations are being designed to facilitate mounting on lamp posts and other street level structures. As it is difficult and costly to provide necessary backhaul connections using fiber to these structures, microwave links using the optimal characteristics of the 71-76 and 81-86 GHz bands are being deployed to support wideband integrated access backhaul solutions.

In an effort to further its goal to expand access to broadband, in 2024[2] the United States' Federal Communication Commission (FCC) agreed to changes to the fixed service rules to allow deployment for smaller, lighter backhaul antennas to facilitate 5G deployments, reducing site costs. Beyond, the fixed service use, the FCC also decided to enable mobile service use for point-to-point communications to aircraft and ships. The FCC also reaffirmed the co-primary status of the fixed-satellite service in the band and that first-in-time priority rights serve as the foundation for coexistence between fixed service and fixed-satellite service in the band.

Satellite systems in the 71-76 GHz and 81-86 GHz bands have also significantly matured since WRC-2000. Thousands of operational satellites use the 71-76 and 81-86 GHz bands today, supported by a ground network of high-capacity gateway earth stations. These networks are essential to accommodate growing demand for high-speed, low-latency satellite broadband service and related applications, including by providing backhaul for end-users in rural and remote areas that lack terrestrial connectivity. Similar to high-capacity fixed wireless backhaul systems, these earth stations use high-gain, directional beams that enable coexistence with fixed service deployments in close proximity.

Recognizing the growing terrestrial use of the 70/80 GHz bands to support future mobile networks, and the increasing number of satellite filings in the frequency bands, WRC-23 agreed to study the protection

[2] FCC Updates Rules in 70/80/90 GHz, available at: https://www.fcc.gov/document/fcc-updates-rules-708090-ghz-bands-0, released Jan 26, 2024.

of terrestrial services from satellites services, under agenda item 1.10 and Resolution **775**.[3] Accordingly, studies should be performed to determine the power flux-density (pfd) and equivalent isotropically radiated power (e.i.r.p.) limits to be included in Article **21** for satellite services (fixed-satellite service (FSS), mobile-satellite service (MSS) and broadcasting-satellite service (BSS)) to protect the current and planned fixed and mobile services in the frequency bands 71-76 GHz and 81-86 GHz.

U.S. VIEW:

The United States supports studies called for in Resolution **775 (Rev.WRC-23)**. The development of pfd and e.i.r.p. limits in Article 21 for the FSS, MSS and BSS must ensure the protection of current and planned fixed and mobile services in the frequency bands 71-76 and 81-86 GHz.

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[3] Resolution **775**, considering *b)* states: "that sharing conditions between the fixed service, mobile service and satellite services in the frequency bands 71-76 GHz and 81-86 GHz could not be fully developed at WRC-2000 due to lack of available information on these services at the time."

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.1: to consider the technical and operational conditions for the use of the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space), or parts thereof, by aeronautical and maritime earth stations in motion communicating with space stations in the fixed-satellite service and develop regulatory measures, as appropriate, to facilitate the use of the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space), or parts thereof, by aeronautical and maritime earth stations in motion communicating with geostationary space stations and non-geostationary space stations in the fixed-satellite service, in accordance with Resolution **176 (Rev.WRC-23).**

BACKGROUND:

Previous WRC's have addressed the spectrum needs and use of aeronautical and maritime ESIM, which includes the adoption of technical and regulatory requirements to allow such operations. In the Radio Regulations, Resolutions **902 (WRC-03)**, **156 (WRC-15)**, **169 (WRC-19)**, **121 (WRC-23)** and **123 (WRC-23)** define technical and regulatory rules to allow ESIM communicating with GSO FSS networks and/or non-GSO FSS systems to provide broadband communications in various frequency bands.

Resolution **176 (Rev.WRC-23)** calls for studies on possible use of frequency bands 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), or parts thereof, by aeronautical and maritime earth stations in motion to communicate with space station in the fixed-satellite service. These studies should assess the spectrum needs for additional A-ESIMs and M-ESIMs, as well as the sharing and compatibility with the services allocated in these frequency bands (and adjacent) on a primary basis. Given Resolution **176** considers both the use of GSO and NGSO ESIMs, the aggregate impact should be accounted for in the studies.

Under Resolution **176 (Rev. WRC-23),** Agenda Item 1.1 considers the frequency band 47.2-50.2 GHz for FSS (Earth-to-space) NGSO A-ESIM and M-ESIM operations. This band is often paired with the 37.5-42.5 GHz FSS (space-to-Earth) frequency band, which is not covered by Resolution **176** and is not addressed under this agenda item. It is noted that under RR No. **21.16.4**, the applicability of the pfd limit values in Table **21-4**, in the bands 37.5-40 GHz and 40.5-42.5 GHz, for space stations operating in NGSO systems with 100 or more satellites is subject to further study.

U.S. VIEW:

The United States supports the sharing and compatibility studies called for in Resolution **176 (WRC-23)**, with a view to ensure the protection of services to which the frequency bands are allocated on a primary basis. Studies should take into account:

- In Region 2, the frequency band 47.2-48.2 GHz is identified for the terrestrial component of IMT (see No. **5.553B**), the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz are identified for HAPS (see No. **5.552A**) and the frequency band 48.2-50.2 GHz is identified for use by high-density applications of the fixed-satellite services (see No. **5.516B).**
- The frequency band 48.94-49.04 GHz is allocated to the radio astronomy service (RAS) on a primary basis, and administrations are urged to take all practicable steps to protect the RAS from harmful interference, in accordance with No. **5.149**.
- The frequency band 50.2-50.4 GHz is allocated to the Earth exploration-satellite service (EESS) (passive), where No. **5.340** applies.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.2: to consider possible revisions of sharing conditions in the frequency band 13.75-14.0 GHz to allow the use of uplink fixed-satellite service earth stations with smaller antenna sizes, in accordance with Resolution **129 (WRC-23)**.

ISSUE:

The use of smaller antenna sizes for Fixed Satellite Service (FSS) earth stations uplinking to geostationary orbit (GSO) and non-GSO (NGSO) in the frequency band 13.75-14.0 GHz requires technical and operational studies to ensure the continued protection of the radiolocation service (RLS) and space research service (SRS), as addressed in Nos. **5.502** and **5.503** of the ITU Radio Regulations (RR).

BACKGROUND: Resolution **129 (WRC-23)** calls for studies on possible revisions of sharing conditions in the frequency band 13.75-14 GHz to allow the use of uplink fixed-satellite service (FSS) earth stations with smaller antenna sizes. In accordance with Administrative Circular CA/270, capturing the decisions made at Conference Preparatory Meeting (CPM-1), Working Party (WP) 4A is responsible for performing these studies.

The frequency band 13.75-14.0 GHz has been subject to regulatory and allocation changes over the years. WARC-92 added an allocation, further revised by WRC-03, to the FSS (Earth-to-space) in this band that impose requirements for minimum size of satellite earth station antennas operating in the 13.75-14 GHz band (1.2 m for geostationary satellite orbit (GSO) networks and 4.5 m for non-geostationary satellite orbit (non-GSO) systems) and on the maximum power flux density that an earth station can transmit towards the sea. WRC-03 introduced changes to Nos. **5.502** and **5.503** that made it possible to use earth station antennas of 1.2 meters for the GSO FSS networks. WRC-03 did not introduce any changes in Nos. **5.502** and **5.503** regarding earth station antennas for NGSO systems.

The purpose of these limitations is to protect the radiolocation and space research services. In addition to the fact that satellite technology has changed tremendously since these conditions were developed 20 years ago, there may also be changes in the SRS and RLS that operate in this band, their applications and co-existence conditions.

Additionally, there is a significant mismatch between available non-planned uplink and downlink FSS spectrum in the 10-15 GHz range for smaller satellite user terminals, e.g., VSATs, satellite news gathering, in all three ITU Regions. In Region 2, the spectrum available for uplink without limitation is only 500 MHz whereas for downlink, it is 1000 MHz, twice the uplink spectrum. Same for Region 1 and 3. This mismatch between uplink and downlink bandwidth highlights the need to identify more uplink capacity that can be efficiently used by smaller antennas that can communicate with GSO and non-GSO satellites.

Innovation both in GSO high throughput satellites (HTS), software defined satellites (SDS) and non-GSO satellites along with innovation in earth station terminals capable of providing large throughputs and broadband connections, has highlighted the critical need for additional Ku-band uplink spectrum to meet the increasing demand for connectivity to customers, particularly for the use of small user terminals, such as VSATs. There has been a rapid increase in number of operational satellite networks and use of orbit and spectrum resources over the last decades corresponding to increased development of a variety of applications and satellite user equipment. Given these advancements FSS customers are requiring higher data transmission rates, smaller user terminals, and increasingly flexible products. From an operational point of view, the frequency band 13.75-14.0 GHz, being adjacent to the 14.0-14.5 GHz (Earth-to-space)

band currently used for uplink, would allow FSS operators to meet the demands of customers in a straightforward and inexpensive manner.

WRC-23 again identified the need for further studies to address the operational and technical limitations regarding the minimum antenna size and associated power limitations for GSO and NGSO FSS earth stations in the 13.75-14.0 GHz band. Resolution **129** (WRC-23) acknowledges the increasing demand for uplink spectrum by smaller antennas for earth stations and the necessity to review sharing conditions with the RLS and SRS to support the evolving needs of FSS applications efficiently and rationally.

U.S. VIEW:

The United States supports possible revisions of sharing conditions in the frequency band 13.75-14.0 GHz to allow the use of uplink FSS earth stations with smaller antenna sizes and revised power limitations. Any possible revisions of sharing conditions in the 13.75-14.0 GHz band to accommodate smaller antenna sizes for uplink FSS earth stations must ensure protection of the RLS and SRS services that operate in the band, and shall not impose any additional constraints on these services. The sharing studies should determine any potential impact from smaller FSS antennas into the RLS and SRS stations and develop provisions to protect these incumbent services from unacceptable interference or performance degradation.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.3: to consider studies relating to the use of the frequency band 51.4-52.4 GHz to enable use by gateway earth stations transmitting to non-geostationary-satellite orbit systems in the fixed-satellite service (Earth-to-space), in accordance with Resolution **130 (WRC□23)**;

BACKGROUND: In accordance with Resolution **130 (WRC-23)**, WRC-27 agenda item 1.3 invites sharing and compatibility studies with existing services, including in adjacent bands, including protection of the fixed and mobile services, and studies relating to the suitability of revising conditions associated with the primary allocation to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) to enable its use by gateway earth stations of non-GSO FSS systems (Earth-to- space), and the relevant regulatory studies.

Considering that satellite systems are increasingly being used to deliver broadband services, they play a crucial role in enabling universal broadband access. Next-generation fixed-satellite service (FSS) technologies are set to enhance broadband speeds significantly, with even faster rates expected shortly. Technological advancements, such as improvements in spot-beam technologies and frequency reuse, are being employed by the FSS in frequency bands above 30 GHz to optimize spectrum efficiency.

Furthermore, fixed-satellite applications in these higher frequency bands, such as feeder links, may be more compatible with other radiocommunication services compared to high-density FSS (HDFSS) applications. For that reason, a new allocation for GSO FSS earth stations in the frequency band 51.4-52.4 GHz were ultimately identified by WRC-19. However, the current frequency allocations to the FSS in the 51.4-52.4 GHz band do not support non-geostationary-satellite orbit (non-GSO) gateway, failing to meet the expected needs of these systems. Report ITU-R S.2461 identified spectrum needs for both GSO and non-GSO FSS earth stations in the frequency band 51.4-52.4 GHz.

The frequency band 51.4-52.4 GHz is allocated on a primary basis in the three Regions to the Fixed-Service and the Mobile Service and is available for high-density applications in the fixed service, as indicated in No. 5.547. The 50.2-50.4 GHz frequency band is also allocated to the Earth exploration-satellite service (EESS) (passive), with non-GSO FSS unwanted emission limits provided in Resolution 750 (Rev.WRC-19). The 52.6-54.25 GHz band is similarly allocated to the EESS (passive). Consideration should be given to possibly revising Resolution 750 (Rev.WRC-19) to include the non-GSO FSS unwanted emission limit for the 52.6-54.25 GHz band and possibly modifying the GSO FSS unwanted emission limit for the same band, based on study results, considering the aggregation of interference into EESS (passive).

U.S. VIEW: The United States supports studies and the development of a regulatory framework to enable use of the frequency band 51.4-52.4 GHz by NGSO FSS gateways (Earth-to-space) in accordance with Resolution **130 (WRC-23),** while ensuring the protection of existing primary services, including terrestrial (Mobile and Fixed) services, GSO FSS in those frequency bands and EESS/SRS (passive) in nearby bands.

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UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

AGENDA ITEM 1.4: to consider a possible new primary allocation to the Fixed-Satellite Service (space-to-Earth) in the frequency band 17.3-17.7 GHz and a possible new primary allocation to the Broadcasting-Satellite Service (space-to-Earth) in the frequency band 17.3-17.8 GHz in Region 3, while ensuring the protection of existing primary allocations in the same and adjacent frequency bands, and to consider equivalent power flux-density limits to be applied in Regions 1 and 3 to non-geostationary- satellite systems in the fixed-satellite service (space-to-Earth) in the frequency band 17.3-17.7 GHz, in accordance with Resolution **726 (WRC-23)**.

BACKGROUND: WRC-23 considered the need to encourage the development and implementation of new technologies in the fixed-satellite service (FSS) for delivery of broadband applications and the mismatch in usable downlink bandwidth in the FSS in Region 3 in the frequency range 17-20 GHz associated with the uplink frequency range of 27-30 GHz. The band 17.3-17.8 GHz is already allocated to the BSS (space-to-Earth) in Region 1. The 17.3-17.7 GHz band is already allocated to the FSS (space-to-Earth) in Region 1 and coexists with BSS feeder links (Earth-to-space) that are subject to Appendix 30A. In addition, WRC-23 agreed a new primary allocation to the FSS in the space-to-Earth direction in the frequency band 17.3-17.7 GHz in Region 2.

In accordance with Resolution **726 (WRC-23)**, WRC-23 invited sharing and compatibility studies between the FSS (space-to-Earth) and BSS (space-to-Earth) with existing services in the frequency band 17.3-17.7 GHz for Region 3 for a possible new allocation to the FSS in the frequency band 17.3-17.7 GHz for Region 3 and to the BSS (space-to-Earth) in the frequency band 17.3-17.8 for Region 3, while ensuring protection of existing primary services, and without adversely affecting the existing allocatios to the FSS (Earth-to-space), including assignments to the BSS feeder links in Appendix **30A**. WRC-23 further invited consideration of the applicability of Region 2 non-GSO FSS epfd limits pertaining to the frequency band 17.3-17.7 GHz to Regions 1 and 3, so as to ensure the protection to GSO networks.

Current satellite communication trends encourage the development and implementation of new technologies in FSS for broadband applications to provide high-capacity and low-cost means of broadband communication even to the most isolated regions of the world. The allocation of the 17.3-17.7 GHz to FSS and 17.3-17.8 GHz to BSS systems in Region 3 would facilitate global harmonization in the use of satellite radiocommunication technology and would facilitate the efficient use of this spectrum worldwide while aligning with the Regions 1 and 2 Table of Allocations. The inclusion of an FSS downlink allocation in 17.3-17.7 GHz in Region 3 and a new BSS allocation in 17.3-17.8 GHz (space-to-Earth), would provide a contiguous amount of FSS spectrum for broadband applications throughout all three Regions.

U.S. VIEW: The United States supports studies, in accordance with Resolution **726 (WRC-23)**, to develop appropriate regulatory provisions to facilitate a new primary allocation to the Fixed-Satellite Service (space-to-Earth) in the 17.3-17.7 GHz band and to the Broadcasting-Satellite Service (space-to-Earth) in the 17.3-17.8 GHz band in Region 3, while ensuring the protection of existing primary allocations in the same and adjacent frequency bands. The inclusion of an FSS downlink allocation in 17.3-17.7 GHz in Region 3 and a new BSS allocation in 17.3-17.8 GHz (space-to-Earth), would provide a contiguous amount of FSS spectrum for broadband applications throughout all three Regions.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-23

Agenda Item 1.5 - to consider regulatory measures, and implementability thereof, to limit the unauthorized operations of non-geostationary-satellite orbit earth stations in the fixed-satellite and mobile-satellite services and associated issues related to the service area of non-geostationary-satellite orbit satellite systems in the fixed-satellite and mobile-satellite services, in accordance with Resolution **14 (WRC-23)**.

BACKGROUND:

WRC-23 considered the active implementation of non-geostationary-satellite orbit (non-GSO) systems in the fixed-satellite service (FSS) and mobile-satellite service (MSS) with a global service area, and reports to the Radio Regulations Board (RRB) from administrations regarding the presence of unauthorized transmissions of transmitting earth stations of non-GSO FSS and MSS systems within their territory. WRC-23 noted that:

- RR No. **18.1** provides that no transmitting station may be established or operated by a private person or by any enterprise without a license issued in an appropriate form and in conformity with the provisions of the Radio Regulations by or on behalf of the government of the country to which the station in question is subject;

- that administrations involved in the provision of satellite services, including notifying administrations of satellite networks or systems, are subject to Article **18**;

- that Resolution **22 (Rev.WRC-23)**, on measures to limit unauthorized uplink transmissions from earth stations, resolves that the operation of transmitting earth stations within the territory of an administration shall be carried out only if authorized by that administration; and

- that Resolution **25 (Rev.WRC-23)**, on operation of global satellite systems for personal communications, resolves that administrations licensing global satellite systems and stations intended to provide public personal communications by means of fixed, mobile or transportable terminals shall ensure, when licensing these systems and stations, that they can be operated only from the territory or territories of administrations having authorized such service and stations in compliance with Articles **17** and **18**, in particular No. **18.1**;

In Resolution **14 (WRC-23)**, taking account of the foregoing, WRC-23 resolved to invite the ITU-R to conduct studies on regulatory measures to limit the unauthorized operations of non-GSO FSS and MSS earth stations in the Earth-to-space direction in order to address and cease such operations, taking into account technical and operational aspects, as appropriate. WRC-23 also invited the ITU-R to conduct studies on regulatory measures (taking into that Member States may wish to exclude their territories from the service area of non-GSO FSS and/or MSS satellite systems) and the implementability of such measures, *without adversely affecting the provision of service in the rest of the service area* of the non-GSO satellite system.

U.S. VIEW:

The United States supports ITU-R studies under Resolution **14 (WRC-23)** to reaffirm that the regulatory measures currently in Article **18** of the Radio Regulations, along with Resolutions **22 (Rev.WRC-23)** and **25 (Rev.WRC-23)**, includes an adequate framework for addressing Earth-to-space unauthorized operations of non-GSO earth stations. As noted in the background, these regulatory provisions contain measures to limit unauthorized uplink transmissions from earth stations and resolves that the operation of

transmitting earth stations within the territory of an administration shall be carried out only if authorized by that administration.

Non-geostationary satellite systems provide crucial communication services worldwide. Additionally, some non-geostationary satellite systems provide essential safety of life communications for global aeronautical and maritime services. Existing regulatory provisions impose mandatory licensing and authorization obligations which respect the sovereignty and regulatory responsibilities of individual Member States. It is important to avoid unnecessary overregulation and ensure the continuity of essential communication services, particularly in emergency and distress scenarios. Any regulatory changes that would negatively affect non-GSO services and undercut the current effective regulatory regime should be avoided.

Given these considerations and the comprehensive nature of the current regulations in Article 18 and Resolutions **22 (Rev.WRC-23)** and **25 (Rev.WRC-23)**, the United States does not see a need for changes to the Radio Regulations under this agenda item.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.11: to consider the technical and operational issues, and regulatory provisions, for space-to-space links among non-geostationary and geostationary satellites in the frequency bands 1 518-1 544 MHz, 1 545-1 559 MHz, 1 610-1 645.5 MHz, 1 646.5-1 660 MHz, 1 670-1 675 MHz and 2 483.5-2 500 MHz allocated to the mobile-satellite service, in accordance with Resolution **249 (Rev. WRC 23)**.

BACKGROUND: WRC-27 is considering taking appropriate regulatory actions for the provision of space-to-space links among non-geostationary and geostationary satellites in the frequency bands 1 518-1 544 MHz, 1 545-1 559 MHz, 1 610-1 645.5 MHz, 1 646.5-1 660 MHz, 1 670-1 675 MHz and 2 483.5-2 500 MHz allocated to the mobile-satellite service to facilitate relaying data from non-geostationary (non-GSO) space stations through satellite systems or networks in the mobile-satellite service.

The landscape of satellite communications has seen a significant uptick in the deployment and operation of small non-geostationary (non-GSO) satellites, particularly those on short-duration missions (e.g. "cubesats"). Considering that many non-GSO small satellites and cubesats traditionally operate with limited and non-real-time connectivity to Earth stations, advancements have explored the potential for continuous access across their orbits, leveraging operating host non-GSO mobile-satellite service (MSS) systems. Concurrently, geostationary (GSO) MSS operators are also providing communications access to LEO satellites via space-to-space links.

The evolving regulatory landscape and the increasing deployment and operation of small non-geostationary (non-GSO) satellites reflect a collective move towards maximizing the utility of satellite networks, which is supported by WRC-27 AI 1.11 studies towards developing the necessary provisions to secure the regulatory recognition for such space-to-space operations while protecting incumbent services.

It is necessary to study the impact on, and to protect, other services, including Earth-to-space and space-to-Earth operation within the MSS, from the operation of space-to-space links in the frequency bands included under this agenda item, taking into account applicable footnotes to the Table of Frequency Allocations, to ensure compatibility with incumbent services in these frequency bands and the adjacent frequency bands and avoid harmful interference. Studies will need to be conducted on the technical and operational characteristics, and protection, sharing and potential compatibility between satellite-to-satellite links and the allocated primary services in the frequency ranges and adjacent bands specified in Resolution **249 (Rev. WRC-23)**. These studies are underway in the ITU.

In accordance with RR No. **5.344**, in the United States the band 1 452-1 525 MHz is allocated to the fixed and mobile services on a primary basis (see also No. **5.343**). RR No. **5.343** prescribes that "In Region 2, the use of the band 1 435-1 535 MHz by the aeronautical mobile service for telemetry has priority over other uses by the mobile service." And RR **5.348B** provides that stations in the mobile-satellite service in 1518-1525 MHz not claim protection from aeronautical mobile telemetry stations in the territory of the United States. Table **21-4** in Article 21 provides stringent power flux-density levels applied to the Mobile-satellite (space-to-Earth) operating in the band 1518-1525 MHz to ensure the protection of aeronautical mobile telemetry applicable to the territory of the United States in the band 1518-1525 MHz.

U.S. VIEW: The United States supports the consideration of appropriate technical and regulatory provisions at WRC-27 to address Resolution **249 (Rev. WRC-23)** and provide for accommodating space-to-space links in the frequency bands 1 518-1 544 MHz, 1 545-1 559 MHz, 1 610-1 645.5 MHz, 1 646.5-1 660 MHz, 1 670-1 675 MHz and 2 483.5-2 500 MHz while ensuring the protection of, and without imposing additional regulatory or technical constraints on, incumbent services in these bands

and adjacent frequency bands.

The United States is also of the view that the studies of space-to-space operations for consideration under this agenda item should be limited to links operating in the same direction of transmission as provided in the current allocations for the mobile-satellite service in the frequency bands under consideration. The U.S. is further of the view that the existing regulatory framework, including that set forth in Article 21 referenced above, and operational practices continue to govern transmissions for the downlink (space-to-Earth) direction, and should be appropriately applied to the space-to-space transmissions, thereby ensuring no additional interference or compatibility issues with incumbent service in the subject and adjacent bands. Additionally, in the frequency band 1518-1525 MHz, the U.S. is of the view that additional regulatory provisions may be necessary to ensure that AMT transmitters are not constrained by new MSS (space-to-space) receivers.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.13: to consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution **253 (WRC-23)**.

BACKGROUND:

As technologies evolve, terrestrial mobile network operators have been looking for ways to extend cellular coverage in order to keep users connected particularly in remote areas. Direct-to-cellular technologies promises to deliver mobile connectivity in previously unreachable areas and allows mobile network operators to extend their existing spectrum holdings to connect unmodified mobile handsets in unserved, or unreachable areas and in the wake of emergencies.

Resolution **253 (WRC-23)** calls for studies to facilitate direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage. Sharing and compatibility studies in bands between 694 - 2 700 MHz identified for IMT in the Radio Regulations and reflected in Recommendation ITU-R M.1036 are essential to ensure the protection of incumbent services, including in adjacent frequency bands in accordance with the Radio Regulations. Resolution **253 (WRC-23)** also calls for possible technical and operational measures to ensure that such envisaged space stations do not cause harmful interference nor claim protection from stations in the mobile service.

In addition, in March of 2024, the United States adopted a domestic regulatory framework —the first of its kind in the world—to enable collaborations between satellite operators and terrestrial service providers using spectrum bands between 600 MHz - 2000 MHz allocated to the terrestrial service in order to expand coverage to a terrestrial licensee's subscribers, especially in remote, unserved, and underserved areas, and increase the availability of emergency communications. The framework adopted is an initial step to encourage the development of Supplemental Coverage from Space ("SCS") while minimizing the risks of harmful interference to existing terrestrial and satellite networks.

Terrestrial wireless broadband operators have made billions of dollars in investments supporting IMT infrastructure supporting the needs of businesses and consumers, which continues to drive the global economy. Introducing new wireless infrastructure carries both opportunities and risks. Studies must confirm that existing terrestrial IMT users are protected against harmful interference as considers are made to support this new type of scaled deployment.

In addition, there are a variety of mission-critical operations in frequency bands between 694 - 2 700 MHz (e.g. aeronautical mobile telemetry, fixed, fixed satellite, radionavigation-satellite, space research, earth exploration satellite and meteorological satellite services) that will make it challenging to adopt an MSS allocation under this agenda item while protecting incumbent users from harmful interference.

U.S. VIEW:

In prioritizing the studies relevant to this agenda item, the United States believes that studies should focus on those frequency bands identified for the terrestrial component of IMT. Studies should take into account the protection of IMT as well as other incumbent services in and or adjacent to these bands, to ensure their protection.

While the U.S. does not support additional MSS spectrum allocations in the frequency bands 1 435-1 525 MHz or 2 360-2 395 MHz for the United States, as these bands are studied, it should be noted that in some countries, the use of the band by the aeronautical mobile service for telemetry has priority over other uses by the mobile service (See No. **5.343** and **5.394**). The U.S. is of the view that PFD values should be incorporated into Article 21 towards the U.S. to ensure in band protection of AMT in the frequency bands 1435-1525 MHz and 2360-2395 MHz, taking into account Recommendation ITU-R M.1459, as well as applying suitable limits in adjacent bands to protect AMT through appropriate regulatory measures. Studies may be necessary as to whether additional constraints beyond those found in Recommendation ITU-R M.1459 are needed to protect AMT.

In addition, since the user equipment would remain the same and regulatory changes to the terrestrial component of IMT are out of scope of the agenda item, the U.S. believes that studies should be limited to the impact of satellite operations in the space-to-Earth direction. As the envisioned space stations would be a complementary service to existing IMT terrestrial operations, any regulatory considerations for the MSS should be on a secondary basis.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.14: studies on possible new frequency allocations to the mobile-satellite service (MSS) in the frequency bands 2 010-2 025 MHz (Earth-to-space) and 2 160-2 170 MHz (space-to-Earth) in Regions 1 and 3 and 2 120-2 160 MHz (space-to-Earth) in all Regions

BACKGROUND:

Current and future MSS systems will deliver more robust voice and data communication applications representing a practical and effective method for delivering connectivity particularly in unserved and underserved areas, and enable access to essential information, educational resources, healthcare services, and economic opportunities. To address the additional MSS spectrum needs to support these benefits, WRC-27 agenda item 1.14 will study the sharing and compatibility between new MSS operations and incumbent services.

Resolution **254 (WRC-23)** explores the feasibility of new MSS frequency allocations in the frequency bands 2 010-2 025 MHz (Earth-to-space) and 2 160-2 170 MHz (space-to-Earth) in Regions 1 and 3 and 2 120-2 160 MHz (space-to-Earth) in all Regions. ITU-R studies will focus on the –

- relevant spectrum requirements and technical, operational, and regulatory matters regarding these possible new MSS allocations;
- protection of existing services that are allocated on a primary basis, as well as services in adjacent frequency bands; and
- possible technical, operational, and regulatory measures to ensure the protection of existing services and their future development.

U.S. VIEW:

The United States supports studies on possible new MSS frequency allocations consistent with Resolution **254 (WRC-23)**. Based on the results of studies, the United States may propose appropriate regulatory action consistent with those study results.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.15: to consider studies on frequency-related matters, including possible new or modified space research service (space-to-space) allocations, for future development of communications on the lunar surface and between lunar orbit and the lunar surface, in accordance with Resolution **680 (WRC-23).**

BACKGROUND:

WRC-27 AI 1.15 aims to address sharing/compatibility studies and spectrum needs related to systems in the space research service (SRS) planned for operations on the lunar surface, or systems in lunar orbit communicating with systems on the lunar surface, in specific frequency ranges, in accordance with Resolution **680 (WRC-23)**.

To support these planned and future lunar and cislunar activities, a variety of communication and position/navigation/timing links are needed, as depicted in Figure 1 below:

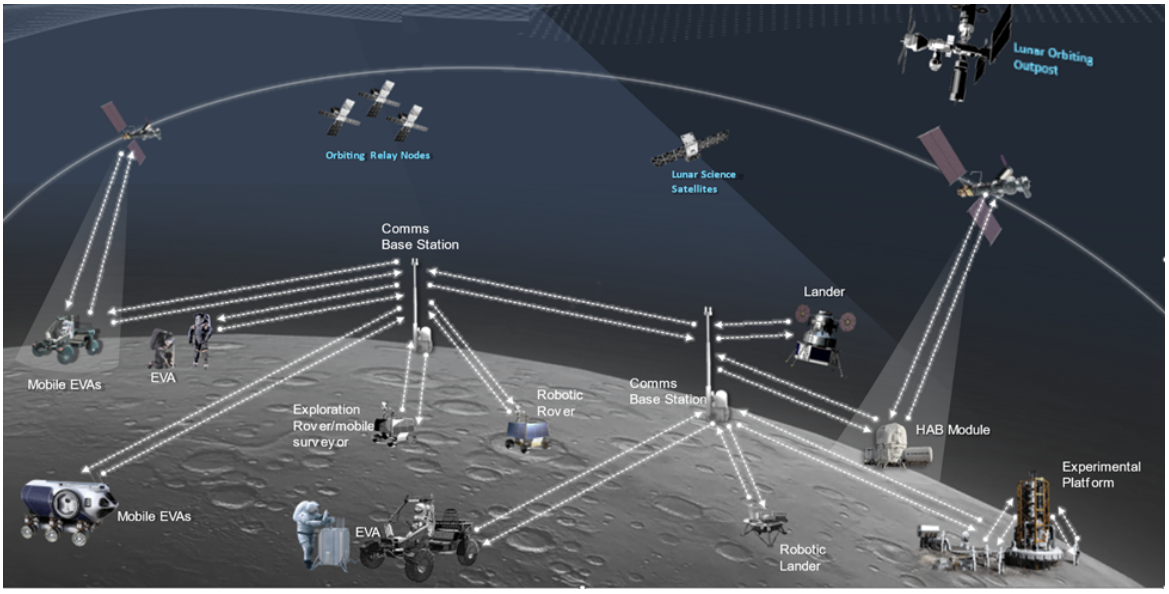

Figure 1. Envisioned Lunar Surface/Lunar Orbit Communication Architecture

In November 2022, the National Science & Technology Council released the National Cislunar Science and Technology Strategy outlining the strategy to advance the United States' scientific, exploration, and economic development activities in Cislunar space. This strategy also affirms the interagency efforts including the Artemis Accords and space related STEM-Education, the ITU Radio Regulations, and technology maturation efforts to pave ways for a long-term robust space economy. To support these planned and future Cislunar activities, basic infrastructure is needed, including communications, PNT (position, navigation and timing), transportation, and radio frequency spectrum management.

Communication between satellites, as well as between the Earth and Earth-orbiting satellites, is already well-defined and understood within the spectrum regulatory environment. In addition to the technical challenges, developing a set of regulatory procedures for on and around the Moon could enable these stations to co-exist without harmful interference and expedite space commerce development in the years to come. As noted in the Director's Report to WRC-23, the Bureau has received enquiries from

administrations and operators about the appropriate services and class of stations to be used for radio stations operating on the surface of the Moon. These include stations that are intended to be used while in motion or during halts at unspecified points or fixed (unrelated to the radio communication service) with respect to on or near the surface of the moon. Based on Article **1** of the Radio Regulations, the Bureau can only classify them as space stations, even if the station will be operating on the surface of the Moon. However, it may be useful in the development of regulatory procedures to create distinct classes of stations to distinguish space stations that are operating on the surface of the Moon, as compared to space stations that are orbiting around the Moon or in outer space.

In the United States, the near-term scientific exploration and discovery objectives are currently being undertaken by NASA in collaboration with industry partners and numerous space agencies around the Region and the world under the Artemis Program. In addition, a series of precursor commercial lander programs are being carried out to conduct technology demonstrations and survey the lunar environment in preparation for a return of humans to the Moon in the next several years, working toward achieving a sustainable and robust presence on the Moon in the next decade.

Technical studies are under way in the ITU-R to enable the implementation of advance wireless technologies for lunar surface direct communications between landers, rovers and extravehicular activity (EVA) astronauts conducting sortie missions, and with systems in lunar orbit. Resolution **680 (WRC-23)** *resolves to invite the ITU Radiocommunication Sector to complete in time for the 2027 world radiocommunication conference 1* to *5* provide the specific framework for studies and scope for which to meet the mission objectives.

The scientific discoveries and technological advancements resulting from the near-term space exploration objective are anticipated to further promote new industries and technologies and accelerate space commerce. To this end, Resolution **680 (WRC-23)** also invites ITU-R, to begin studies and provide a progress report through the Director of the BR to WRC-27 regarding future radiocommunications needs for activities in the lunar vicinity beyond space research, considering existing space radiocommunication services and regulatory provisions.

US VIEW:
The U.S. supports the studies called for under Agenda Item 1.15, including studies of potential new or modified frequency allocations and/or identifications to the SRS with appropriate regulatory provisions, for communications on the lunar surface or in lunar orbit communicating with systems on the lunar surface. The sharing and compatibility studies should take into account provisions to protect the unique environment of the Shielded Zone of the Moon (SZM) for radioastronomical measurements, the spectrum needs of systems operating in the lunar environment, and taking into account the unique propagation considerations of the Moon, the protection of incumbent services in the frequency bands listed in Resolution **680 (WRC-23)**.

The United States also supports ITU-R regulatory studies on the appropriate regulatory procedures for stations on the Moon in order to facilitate notification to the BR.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.16: to consider studies on the technical and regulatory provisions necessary to protect radio astronomy operating in specific Radio Quiet Zones and, in frequency bands allocated to the radio astro nomy service on a primary basis globally, from aggregate radio-frequency interference caused by non-geostationary-satellite orbit systems, in accordance with Resolution **681 (WRC-23)**.

BACKGROUND:

In accordance with Resolution **681 (WRC-23)**, WRC-27 agenda item 1.16 invites studies on how the interference from unwanted emissions from non-GSO satellite systems operating in the adjacent bands to a set of RAS primary frequency bands affects the operation of RAS stations. Table 1 provides the information for the frequency bands of interest.

Table 1

Radio astronomy frequency band	Active space service operating in adjacent or nearby frequency band	Active space service (space-to-Earth)	Scope
10.6-10.7 GHz	10.7-10.95 GHz	FSS	*Resolves etc.* 1 and 2
42.5-43.5 GHz	42-42.5 GHz	FSS	*Resolves etc.* 2
76-77.5 GHz	74-76 GHz	FSS, MSS	*Resolves etc.* 2
94.1-95 GHz	95-100 GHz	RNSS, MSS	*Resolves etc.* 2
100-102 GHz	95-100 GHz	RNSS, MSS	*Resolves etc.* 1 and 2
114.25-116 GHz	116-119.98 GHz	ISS	*Resolves etc.* 1 and 2
130-134 GHz	123-130 GHz	FSS, MSS, RNSS	*Resolves etc.* 2

Additionally, Resolution **681** calls for studies on the possible recognition of the two specific RQZs listed below, and the impact of non-GSO systems operation on these two sites:

– the Square Kilometre Array Observatory in South Africa;
– the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile

The Resolution does not explain what is meant by recognition and does not address the fact that many frequency bands used at these two sites are not allocated to the radio astronomy service.

U.S. VIEW:

The United States supports conducting the sharing and compatibility studies called for in Resolution **681 (WRC-23)**, *resolves 1* to 2 and limited to the frequency bands in Table 1 of Resolution 681 (WRC-23) where the Radio Astronomy Service (RAS) is allocated on a primary basis.

With respect to the RQZ studies for the two identified sites, the United States is of the view that there are important issues to be addressed regarding *resolves* 3 to 6, including the meaning of "recognition" and taking proper account of the status of frequency allocations in the ranges used for observations at the two sites. These studies should focus on providing tools that help manage the coexistence without the need for changes to the Radio Regulations and take into account the allocation status of the services in each

frequency band in which observations are conducted. It is important not to take actions that could impose undue constraints on NGSO operations critical for global communications infrastructure.

Accordingly, the United States does not support any changes to the Radio Regulation as a result of the activities undertaken with respect to Resolution **681 (WRC-23)** *resolves 3 to 6***.**

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UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.17: to consider regulatory provisions for receive-only space weather sensors and their protection in the Radio Regulations, taking into account the results of ITU Radiocommunication Sector studies, in accordance with Resolution **682 (WRC23)**.

BACKGROUND:

Space weather events can cause harm to important sectors of national economies, security and human welfare. As such, space weather data is important, and regulatory protection is needed for space weather observation systems, including receive-only sensors that measure low-level emissions from sources such as the Sun, the Earth's atmosphere and other celestial bodies. Article **29B** and Resolution **675 (WRC-23)** defines space weather and designates space weather sensors to the meteorological aids service in the subset MetAids (space weather). However, no notification of frequency assignments to a station used for space weather observation be made by administrations under MetAids (space weather) until WRC-27 introduces the corresponding allocations in Article **5.**.

Resolution **682 (WRC-23)** calls for studies on system characteristics, spectrum needs, and appropriate protection criteria for receive-only space weather sensors. Additionally, it calls for sharing and compatibility studies of receive-only sensors for potential new primary allocations to MetAids (space weather) in six specific frequency bands (27.5-28.0 MHz, 29.7-30.2 MHz, 32.2-32.6 MHz, 37.5-38.325 MHz, 73.0-74.6 MHz and 608-614 MHz) without claiming protection from, or constraining the future development of, incumbent services in these or adjacent frequency bands. Lastly, it calls for studies on possible regulatory provisions to accommodate the notifications of receive-only space weather sensor stations for inclusion in the Master International Frequency Register (MIFR).

The importance of space weather radiocommunication applications has been emphasized by several international bodies, including the World Meteorological Organization (WMO), the Intergovernmental Panel on Climate Change (IPCC), the United Nations Office for Disaster Risk Reduction (UNDRR), the International Civil Aviation Organization (ICAO), the United Nations Office for Outer Space Affairs (UNOOSA). Furthermore, Resolution **136** (Rev. Bucharest, 2022) of the Plenipotentiary Conference underscores the important role of telecommunications and information technologies in monitoring, early warning, prevention and mitigation of emergency and disaster situations.

In carrying out the studies under WRC-27 agenda item **1.17**, it is important to recognize that while space weather data products are used for forecasts and warnings related to public safety, the provisions of No. **1.59** and **4.10** do not apply. Additionally, it is important to recognize that the current provisions of Article **11** do not allow an administration to notify a frequency assignment to a receive-only terrestrial radio station, except for certain types of station (see **11.2**, **11.9** and **11.12**). Therefore, the procedure for notifying receive-only MetAids (space weather) stations currently does not exist. Furthermore, some receive-only space weather sensors in operation utilize bands not currently allocated to the MetAids service, and some of these sensors need to continue their current operation. Lastly, the studies under this agenda item consider receive-only space weather sensors with the understanding that they will be deployed only at a limited number of specific locations and not in a ubiquitous manner.

Report ITU-R RS.2456 provides information on radio spectrum-reliant sensors and systems that are operating in support of space weather monitoring, prediction and warnings. Additionally, there are ongoing efforts within ITU-R to determine the spectrum requirements and protection criteria of receive-only space weather sensors.

As stated in Resolution **682 (WRC-23)**, any new allocations to MetAids (space weather) shall not claim protection from, or constrain the future development of, incumbent services in the frequency bands considered in the Resolution, or in adjacent bands. For the 608 – 614 MHz band, there are a number of allocations, among those include the broadcasting service on a primary basis in Regions 1 and 3 and in the adjacent bands in Region 2. Further, this band is also allocated to the mobile service on a primary basis in Region 3 and on a secondary basis in Europe. In the adjacent bands, among other allocations, the mobile service is allocated on a primary basis, including IMT identifications in several countries in the ASMG, CITEL and APT regions. The adoption of IMT in these regions is expected to grow in the future, providing wide-area wireless broadband coverage.

U.S. VIEW:

The United States recognizes that space weather phenomena pose a significant threat to ground-based and space-based critical infrastructure, modern technological systems, and humans working in space. The United States supports the consideration of new primary allocations to MetAids (space weather) in the six specified frequency bands and the associated regulatory provisions for ground-based, receive-only space weather sensors in the Radio Regulations, taking into account the results of the studies under Resolution **682 (WRC-23)**. Any allocations to MetAids (space weather) made at WRC-27 shall not claim protection from or constrain the future development of incumbent services in the specified frequency bands or in adjacent bands.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.18: to consider, based on the results of ITU Radiocommunication Sector studies, possible regulatory measures regarding the protection of the Earth exploration-satellite service (passive) and the radio astronomy service in certain frequency bands above 76 GHz from unwanted emissions of active services, in accordance with Resolution **712 (WRC-23)**.

ISSUE: The Earth exploration satellite service (EESS) (passive) and radio astronomy service (RAS) are highly susceptible to unwanted emissions from active radio services operating in adjacent frequency bands. The current regulatory provisions and procedures may require review to ensure protection of the EESS (passive) and the RAS in certain frequency bands above 76 GHz from unwanted emissions of certain active services.

BACKGROUND:

The WRC-2000 made various allocation changes to the frequency bands above 71 GHz, including primary allocations to the Earth exploration-satellite service (EESS) (passive) subject to No. 5.340, based on the requirements known at the time of that conference. Primary allocations have also been made to various active services in frequency bands adjacent to frequency bands above 86 GHz allocated to the EESS (passive) subject to No. 5.340. While some active systems are under development, in many of the bands above 76 GHz the planned use is still in a nascent state. As noted in Resolution **731**, the sharing criteria for active and passive services in the frequency bands above 71 GHz have not been fully developed within the ITU and that to the extent practicable, the burden of sharing among active and passive services should be equitably distributed among the services to which allocations are made. Additionally, primary service allocations have been made in adjacent frequency bands to the radio astronomy service (RAS) and various space services, such as the fixed-satellite service (FSS), mobile-satellite service (MSS), broadcasting-satellite service (BSS), and radionavigation-satellite service (RNSS), in frequency bands above 76 GHz. In many cases, because the frequencies used by EESS (passive) sensors and stations of the RAS are chosen to study natural phenomena producing radio emissions at frequencies fixed by the laws of nature, it is not possible for EESS (passive) or RAS stations to shift frequencies to avoid or mitigate interference problems.

Resolution **750 (Rev. WRC-19)** and Resolution **739 (Rev. WRC-19)** contain unwanted emission limits applied to the active services to ensure protection of the EESS (passive) and RAS, respectively.

Resolution **712 (WRC-23)** called for compatibility studies between the EESS (passive) and corresponding active services listed in Table 1 below, and between the RAS and the active satellite services in the adjacent bands listed in Table 2 below (with a view to setting the relevant threshold levels for unwanted emissions from any GSO and non-GSO space stations and revising and updating Resolution **739 (Rev.WRC-19**) accordingly).

TABLE 1

EESS (passive) frequency bands to be studied and corresponding active services to be included

EESS (passive) frequency band	Active service frequency band	Active service
86-92 GHz	81-86 GHz	Fixed-satellite service (FSS) (Earth-to-space), mobile service (MS)

	92-94 GHz	MS, radiolocation service (RLS)
114.25-116 GHz	111.8-114.25 GHz	Fixed service (FS), MS
164-167 GHz	158.5-164 GHz	FS, FSS (space-to-Earth), MS, mobile-satellite service (MSS) (space-to-Earth)
	167-174.5 GHz	FS, FSS (space-to-Earth), inter-satellite service (ISS), MS
200-209 GHz	191.8-200 GHz	FS, ISS, MS, MSS, radionavigation service (RNS), radionavigation-satellite service (RNSS)
	209-217 GHz	FS, FSS (Earth-to-space), MS

TABLE 2

RAS frequency bands to be studied and corresponding active services to be included

Radio astronomy frequency band	**Active satellite service frequency band**	**Active satellite service (space-to-Earth)**
76-81 GHz	71-76 GHz	Fixed-satellite service (FSS), mobile-satellite service (MSS), broadcasting-satellite service (BSS)
130-134 GHz	123-130 GHz	FSS, MSS, radionavigation-satellite service (RNSS)
164-167 GHz	167-174.5 GHz	FSS
226-231.5 GHz	232-235 GHz	FSS

Resolution **712 (WRC-23)** also invited WRC-27 to determine, based on study results, any regulatory measures regarding the protection of the EESS (passive) in the frequency bands listed in Table 1 above from unwanted emissions of active services and update Resolution **750 (Rev.WRC-19)** accordingly, and to determine, based on the results of studies, any required regulatory measures regarding the protection of the RAS in the frequency bands listed in Table 2 above and update Resolution **739 (Rev.WRC-19)** accordingly.

U.S. VIEW:
The United States supports conducting the compatibility studies, based on available characteristics of the active services, called for in Resolution **712 (WRC-23)**, between the EESS (passive) and the corresponding active services in adjacent frequency bands as listed in Table 1. Further, the United States supports conducting the compatibility studies between the RAS and the active satellite services in frequency bands listed in Table 2.

The U.S. also supports, based on ITU-R study results, potential development of recommended regulatory measures to ensure compatibility of the EESS (passive) / RAS without overly burdening the current and future use of active services in the studied frequency bands. These studies should take into account Resolution 731 and the principle of burden sharing between passive and active services.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS FOR WRC-27

Agenda Item 1.19: to consider possible primary allocations in all Regions to the Earth exploration-satellite service (passive) in the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz, in accordance with Resolution **674 (WRC-23)**.

BACKGROUND:

For years, the frequency band 6 425 – 7250 MHz has been utilized by opportunistic use (i.e. no allocation) of the Earth exploration-satellite service (EESS) (passive) for operations carried out over oceans (see No. **5.458**). EESS passive sensing may also be authorized in the frequency band 4 200-4 400 MHz on a secondary basis (see Radio Regulation (RR) No.**5.437**).

In accordance with Resolution **674 (WRC-23)**, WRC-27 agenda item 1.19 invites studies on the use of the EESS (passive) to perform sea surface temperature (SST) measurements for detecting and forecasting meteorological events in the complementary frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz. SST, together with ocean salinity, is one of the drivers of the ocean circulation, which is key for any numerical weather prediction (NWP) or numerical ocean prediction (NOP) models. SST is also a critical variable for climatological studies and for the assessment of global temperature trends, and it is fundamental to understand the exchanges of heat, gas and momentum between the atmosphere and the ocean, and in calculations of carbon uptake by the ocean from the atmosphere. Global maps of SST are also important for commercial applications such as fishery assessment.

The frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz, as well as adjacent bands, are utilized by several active radiocommunication services. The frequency band 4 200-4 400 MHz is allocated to the primary aeronautical mobile (Route) service (AM(R)S) for use of wireless avionics intra-communication systems (WAIC) under RR No. **5.436**, and to the primary aeronautical radionavigation service (ARNS) for use of radio altimeters onboard aircraft and associated transponders on ground under RR No. **5.438**. In the adjacent band 3 600-4 200 MHz, the mobile service is allocated on a primary basis in Regions 2 and 3, and a secondary basis in Region 1, and is currently being operated or under study for mobile broadband use in many countries. Furthermore, the frequency bands 3 600-4 200 MHz and 4 500-4 800 MHz are allocated to fixed satellite services (space-to-Earth), for use by satellites beams with full or partial ocean overlap. The frequency band 7 900-8 400 MHz is allocated on a primary basis to fixed, mobile, and fixed-satellite service (Earth-to-space). Noting the sensitivity of the EESS receivers taking temperature measurements of the sea surface, any allocation to the EESS (passive) under this agenda item cannot claim protection from existing services in these frequency bands, or adjacent bands, per Resolution **674 (WRC-23)**.

It is worth noting that WRC-23 deliberated on aspects of several agenda items pertaining to EESS passive systems seeking protection from active services operating in adjacent bands. The source of interference was mentioned as emissions from active systems reflected from the sea surface in all of these scenarios. Studies were conducted showing this interference causes EESS passive measurements to be corrupted and the collected data to be unusable.

It should also be noted that WRC-27 agenda item 1.19 considers frequency bands that are adjacent to those under consideration of WRC-27 agenda item 1.7, based on studies of the technical, operational and regulatory issues pertaining to the possible use of the terrestrial component of IMT. Agenda item 1.19 studies should take into account the potential impact of IMT systems being studied under agenda item 1.7 in the adjacent frequency bands, noting any use of EESS (passive) could not claim protection from the use of the mobile service (including IMT) operating in the adjacent bands.

U.S. VIEW:

The United States supports conducting the sharing and compatibility studies called for in Resolution **674 (WRC-23).** Given the current and planned use of active service systems operating in, and adjacent to, the frequency bands 4 200-4 400 MHz (e.g. aeronautical mobile (R), aeronautical radionavigation, fixed, fixed-satellite and mobile) and 8 400-8 500 MHz, first, the technical viability and overall practicality of designating new primary allocations for EESS (passive) service within the specified frequency bands needs to be ascertained. Second, any allocation to the EESS (passive) under this agenda item should not claim protection from current and future applications of the incumbent services, both in-band and adjacent. Finally, studies should take into account, without claiming protection, the possible impact of studies under WRC-27 agenda item 1.7 concerning the potential identification of the adjacent frequency band 8 215-8 400 MHz for IMT systems.

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Attachment B

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, D.C. 20230

Ms. Nese Guendelsberger
Deputy Chief, Office of International Affairs
Federal Communications
Commission 45 L Street NE
Washington, DC 20554

Dear Ms. Guendelsberger:

The National Telecommunications and Information Administration (NTIA), on behalf of the Executive Branch agencies, provides the attached WRC-27 preliminary views for Agenda Items 1.2 addressing smaller antenna sizes for FSS uplinks at 14 GHz, 1.9 addressing Appendix 26 aeronautical HF modernization, 1.13 addressing new allocations to MSS for IMT, 1.15 addressing Lunar Comms, and 1.16 addressing Radio Quiet Zones.

NTIA looks forward to working with FCC in reconciling these preliminary views for submission to CITEL PCC II as U.S. views. Our point of contact is Mr. Charles Glass, NTIA's WRC Coordinator, who can be reached at (202) 714-1763 or cglass@ntia.gov.

Sincerely,

Derek Khoplin July 11, 2024

Derek Khlopin
Deputy Associate Administrator
Office of Spectrum Management

Enclosures (x)

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.2: to consider possible revisions of sharing conditions in the frequency band 13.75-14 GHz to allow the use of uplink fixed-satellite service earth stations with smaller antenna sizes, in accordance with Resolution 129 (WRC-23).

ISSUE:

The utilization of smaller antenna sizes for uplink geostationary orbit (GSO) and non-GSO (NGSO) fixed satellite service (FSS) earth stations in the frequency band 13.75-14 GHz requires thorough technical and operational studies to support potential regulatory changes while ensuring the continued protection of the radiolocation service (RLS) and space research service (SRS), as addressed in Nos. 5.502 and 5.503 of the ITU Radio Regulations (RR).

BACKGROUND:

The frequency band 13.75-14 GHz has been subject to regulatory and allocation changes over the years, reflecting the evolving needs of the satellite communication sector. WARC-92 added an allocation, further revised by WRC-03, to the FSS (Earth-to-space) in this band and described sharing conditions with RLS in Nos 5.502 and for SRS in 5.503. WRC-03 introduced changes to Nos. 5.502 and 5.503 that made it possible to use earth station antennas as small as 1.2 meters for the GSO FSS networks. For GSO earth station antennas in the range of 1.2 to 4.5 meters, the power flux-density (pfd) and equivalent isotopically radiated power (e.i.r.p.) density are limited. WRC-03 did not introduce any changes in Nos. 5.502 and 5.503 regarding earth station antennas for NGSO systems.

WRC-23 again identified the need for further studies to address the operational and technical limitations regarding the minimum antenna size and associated power limitations for GSO and NGSO FSS earth stations in the 13.75-14 GHz band. Resolution 129 (WRC-23) acknowledges the increasing demand for uplink spectrum by smaller antennas for earth stations and the necessity to review sharing conditions with the RLS and SRS to support the evolving needs of FSS applications efficiently and rationally.

U.S. VIEW:

The United States is of the view that any possible revisions of sharing conditions in the 13.75-14 GHz band to accommodate smaller antenna sizes for uplink FSS earth stations must ensure protection for existing services, particularly RLS and SRS, and shall not impose any additional constraints on these services.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.9: to consider appropriate regulatory actions to update Appendix **26** to the Radio Regulations in support of aeronautical mobile (OR) high frequency modernization, in accordance with Resolution **411** (**WRC-23)**;

ISSUE:

The High Frequency (HF) band has been identified as an effective alternative to provide much needed integrated and interoperable Beyond-Line-of-Sight (BLOS) communications capabilities. HF is also a critical and affordable option for global broadcasting and amateur radio, and an alternative when other communications services are unavailable due to natural disasters or other national emergencies. Commercial financial institutions are exploring the use of HF long-distance delivery for financial users requiring low latency data. The challenge with meeting the growing requirement for modern HF is the need for the increased bandwidth allocations that would be required to achieve HF's advantages while not impeding the legacy frequency needs of incumbent users, groups, or countries.

There are modern wide band HF (WBHF) technologies available that enable the flexibility to use wider channel bandwidths within advanced digital HF and enhanced applications that can support a shared environment while also maximizing spectrum efficiency. Current wideband technology and methodologies are available that automate the negotiating of the Radio Frequency (RF) environment while mitigating any harmful interference to users in, or adjacent to, a desired HF frequency range.

Appendix 26 of the ITU Radio Regulations limits Aeronautical Mobile (OR) to a maximum bandwidth of 2.8 kHz.

BACKGROUND:

WRC-23 through Resolution 411 (WRC-23) resolves to invite the Radiocommunication Sector to review Appendix 26 of the Radio Regulations and consider necessary changes, as appropriate, to Appendix 26, on the basis of studies without modifying the existing area allotments, and while taking into account that the current use of the narrowband systems shall remain unchanged and shall not be impacted nor precluded by the revision of Appendix 26.

U.S. VIEW:

The U.S. supports updating Appendix 26 of the Radio Regulations in the following bands allocated to AM(OR)S as long as sharing studies show the ability of HF wideband systems to ensure compatibility with incumbent and adjacent allocations:

- 3025 – 3155 kHz
- 3900 – 3950 kHz
- 4700 – 4750 kHz
- 5680 – 5730 kHz
- 6685 – 6765 kHz
- 8965 – 9040 kHz
- 11175 – 11275 kHz
- 13200 – 13260 kHz
- 15010 – 15100 kHz

- 17970 – 18030 kHz

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.13: to consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution **253 (WRC-23)**;

ISSUE: ITU-R will study possible allocations to the MSS in the frequency range between 694/698 MHz and 2.7 GHz, taking into account the IMT frequency arrangements addressed in the most recent version of Recommendation ITU-R M.1036;

In addition, ITU-R will:

- Perform studies on spectrum requirements and on technical, operational and regulatory matters related to the implementation of the mobile-satellite service for direct connectivity to the IMT user equipment to complement the terrestrial IMT network coverage.
- Conduct studies on sharing and compatibility between incumbent services, including in adjacent frequency bands, ensuring the protection of incumbent services in accordance with the Radio Regulations.
- Study possible technical and operational measures to ensure that the stations in the MSS do not cause harmful interference to, or claim protection from, stations operating in the mobile service.

BACKGROUND:

U.S. did not submit a Future Agenda Item proposal to WRC-23 on this item. The U.S. was not a signatory to the CITEL IAP, which listed specific bands (listed below) all within the overall range of Resolution **253 (WRC-23)**:

- 694-960 MHz;
- 1 710-2 025 MHz;
- 2 110-2 200 MHz;
- 2 300-2 400 MHz;
- 2 500-2 690 MHz

The U.S. would like to clarify that the required sharing and compatibility studies include terrestrial, space, and other non-terrestrial services operating in the bands and in adjacent bands. Further, while the proposed new MSS stations would be effectively secondary to stations operating in the mobile service, that should not be seen to imply that other systems with primary allocations or those in operation as a secondary service should not be protected.

The U.S. is aware of advances in technology allowing direct connections between user handsets and satellites as a supplemental means to communicate when terrestrial IMT network coverage is not available.

In the possible case of co-frequency terrestrial IMT and MSS operation, where the MSS is complementing terrestrial IMT network coverage, the U.S. considers it important that the operators of IMT system be responsible for the use of the co-frequency terrestrial and satellite spectrum resources.

The U.S. interprets the intent of Resolution **253 (WRC-23)** (particularly, but not exclusively, *considering* c, *noting* f, *recognizing* d, and the *resolves* and *further resolves*) to limit the studies within the frequency range 694/698 – 2 700 MHz to bands already allocated by the ITU to the mobile service and identified by footnote for IMT. The ITU-R Radio Regulations and Recommendations provide instruction and/or guidance as to which bands within the frequency range are appropriate for new MSS allocations and thus should be studied; they also provide instruction and/or guidance as to which bands within the frequency range are not appropriate for new MSS allocations and thus should not be studied.

The U.S. has national rules that provide further constraints and/or guidance as to which bands should be studied, or which bands should not be studied. A final criterion for which bands should be studied is an examination of the specific use of the bands, and eliminating those where the U.S. use appears to present technical challenges to sharing by the proposed new MSS. As part of this, the US does not support direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage in frequency bands above 2000MHz.

Thus, the U.S. Preliminary View of which bands should be studied for WRC-27 Agenda Item 1.13 is a sub-set of the bands in the frequency range 694/698 – 2 700 MHz already allocated by the ITU to the mobile service and identified by footnote for IMT, with further considerations. The specific bands are listed in the U.S. View section. For reference, the Annex contains a list of bands which the U.S. believes should not be studied.

U.S. VIEW:

The U.S. view is that WRC-27 Agenda Item 1.13 shall only study bands already allocated to the mobile service AND identified by footnote for IMT listed below.

694/698 - 902 MHz

902 - 908 MHz (R1 & R3 only; not R2)

908 - 960 MHz

1 710 - 1 755 MHz

1 850 - 2 000 MHz

These studies should take in-band and adjacent band issues into account, as well as harmonic impacts to bands allocated to the radio astronomy service (see *Recognizing f*).

The results of studies supporting Agenda Item 1.4 (WRC-23) showed sharing between HIBS operating in the 2 500-2 690 MHz frequency band and ARNS and Meteorological Radars operating in the 2 700 – 2 900 MHz frequency band may be feasible when considering a PFD limit. As such, studies conducted under AI 1.13 (WRC-27) should also determine a PFD limit sufficient to protect the incumbent services operating in the 2 700-2 900 MHz frequency band.

Proper considerations for incumbent services, including in adjacent frequency bands, should be studied under this agenda item. The U.S. supports that the stations in the MSS being considered under AI 1.13 (WRC-27) do not cause harmful interference to, or claim protection from, stations operating in the mobile service. Additionally, it is important to limit studies to bands already identified for IMT.

ANNEX

List of bands within the frequency range 694/698 - 2 700 MHz
which the U.S. believes should not be studied

Band (MHz)	Description
902-908	Not identified for IMT in R2 by ITU footnotes. (See RR No. **5.317A**.)
960-1164	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. Internationally standardized civil aviation systems in AM(R)S and ARNS safety services.
1164-1300	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. Allocated to RNSS on a primary basis and used by GPS. Internationally standardized civil aviation systems in ARNS (inc'l RR No. **5.331**) safety service and RNSS and RLS.
1300-1390	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. Internationally standardized civil aviation systems in 1300-1370 MHz in ARNS safety service (inc'l RR No. **5.334**).
1390-1395	Not identified for IMT by ITU footnotes; not in M.1036. Keeping this frequency range clear as much as possible remains of high importance to radio astronomy operations (see 1400-1427, below).

Band (MHz)	Description
1395-1400	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. Keeping this frequency range clear as much as possible remains of high importance to radio astronomy operations (see 1400-1427, below; also note the need to study for harmonics impacts to the 2690-2700 MHz range, as specified in the AI 1.13 associated Resolution **253 (WRC-23)**).
1400-1427	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Exclusive passive frequency band: • RR No. **5.340 "**All emissions are prohibited in the following bands: 1 400-1 427 MHz, … (WRC-03)" • **US246 "**No station shall be authorized to transmit in the following bands: … 1400-1427 MHz, …" Not identified for IMT by ITU footnotes; not in M.1036. This is THE fundamental/workhorse band for radio astronomy, as it contains the ubiquitous 21 cm neutral hydrogen line crucial for galactic and extragalactic structure/velocity detection. This band and that below it (due to doppler/redshift) are crucial for radio astronomy operation. In use by 10 stations of VLBA, the VLA, Green Bank Observatory, among many others in the U.S. and around the world (U.S. funded).
1427-1518	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. US uses this band for Aeronautical Mobile Telemetry. Immediately adjacent frequencies to the crucial 1400-1427 MHz range; may represent a significant out-of-band interference challenge for passive systems such as radio astronomy.
1518-1559	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. NOAA utilizes 1544-1545 MHz band for search and rescue satellite (SARSAT) downlink: • RR No. **5.356** "The use of the band 1544-1545 MHz by the mobile-satellite service (space-to-Earth) is limited to distress and safety communications" Internationally standardized civil aviation systems in MSS (space-to-Earth) with AMS(R)S access by footnotes, see Resolution **222 (Rev.WRC-23)**.

Band (MHz)	Description
1559-1610	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. Allocated to RNSS on a primary basis and used by GPS. Internationally standardized civil aviation systems in ARNS safety services and RNSS and MSS.
1610-1670	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. **US246 "**No station shall be authorized to transmit in the following bands: … 1660.5-1668.4 MHz, …." Not identified for IMT by ITU footnotes; not in M.1036. Primary allocations in the 1610.6-1613.8 MHz and 1660.5-1670 MHz range represent a profound sharing challenge, particularly with space-to-Earth transmissions. Significant work completed in protecting the 1610.6-1613.8 MHz range as recognized in RR No. **5.372**. In use by 10 stations of the VLBA, VLA, Green Bank Observatory. Internationally standardized civil aviation systems in 1610-1660.5 MHz in AMS(R)S safety services (inc'l Resolution **222 (Rev.WRC-23))**
1670-1675	Not identified for IMT by ITU footnotes; not in M.1036.
1675-1710	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. US uses the 1675-1695 MHz band for significant satellite downlinks.

1755-1850	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Significant US operations including satellite uplinks in 1761-1842 MHz.
2000-2700	**The utilization of S/X band (above 2 GHz) for critical radio observations to provide input data to the celestial reference frame which underpins the RNSS service is a U.S. priority.**

Band (MHz)	Description
2025-2110	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes. Footnote to the title of §5 of M.1036: "The 2025-2110 MHz band is not part of the frequency arrangements" RR No. **5.391 "**In making assignments to the mobile service in the frequency bands 2 025-2 110 MHz and 2 200-2 290 MHz, administrations shall not introduce high-density mobile systems, as described in Recommendation ITU-R SA.1154-0, and shall take that Recommendation into account for the introduction of any other type of mobile system. (WRC-15)" US utilizes 2025-2110 MHz band for command and satellite management uplinks; Critical band for US satellite operations.
2200-2290	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. RR No. **5.391 "**In making assignments to the mobile service in the frequency bands 2 025-2 110 MHz and 2 200-2 290 MHz, administrations shall not introduce high-density mobile systems, as described in Recommendation ITU-R SA.1154-0, and shall take that Recommendation into account for the introduction of any other type of mobile system. (WRC-15)" US utilizes 2200-2290 MHz band for data acquisition and communications downlinks; Critical band to US satellite operations.
2290-2300	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036. Primary SRS deep space (s-E) in 2290-2300 MHz.
2360-2395	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. By RR No. **5.394**, US uses this band for Aeronautical Mobile Telemetry.
2400-2417	Not identified for IMT by ITU footnotes; not in M.1036.
2417-2450	Not identified for IMT by ITU footnotes; not in M.1036.

Band (MHz)	Description
2450-2483.5	Not identified for IMT by ITU footnotes; not in M.1036.
2483.5-2500	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Not identified for IMT by ITU footnotes; not in M.1036.

2690-2700	FCC's SCS R&O 14Mar24 is not supported in bands with USG primary allocations. Exclusive passive frequency band: • RR No. **5.340 "**All emissions are prohibited in the following bands: … 2 690-2 700 MHz, except those provided for by No. **5.422**, … (WRC-03)" • **US246 "**No station shall be authorized to transmit in the following bands: … 2690-2700 MHz, …" Not identified for IMT by ITU footnotes; not in M.1036. This band is used for continuum observations, including by the VLBA (10 stations), the VLA, and Green Bank Observatory, as well as geodetic VLBI measurements key to maintaining RNSS system accuracy.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.15: to consider studies on frequency-related matters, including possible new or modified space research service (space-to-space) allocations, for future development of communications on the lunar surface and between lunar orbit and the lunar surface, in accordance with Resolution **680 (WRC-23);**

BACKGROUND:

WRC-27 AI 1.15 aims to address in-situ near-term scientific exploration and discovery objectives in time for decision by WRC-27, and to initiate studies to identify spectrum needs for future space activities beyond space research to enable cislunar long duration human presence to support consideration of other relevant radiocommunication services for actions by a future competent world radio conference beyond WRC-27.

In November 2022, the National Science & Technology Council released the National Cislunar Science and Technology Strategy outlining the strategy to advance the United States' scientific, exploration, and economic development activities in Cislunar space. This strategy also affirms the interagency efforts including the Artemis Accords and space related STEM-Education, the ITU Radio Regulations, and technology maturation efforts to pave ways for a long-term robust space economy.

In the United States, the near-term scientific exploration and discovery objectives are currently being undertaken by NASA in collaboration with US industry partners and numerous space agencies around the world under the Artemis Program. In addition, a series of precursor commercial lander programs are being carried out to conduct technology demonstrations and survey the lunar environment in preparation for a return of humans to the Moon in the next several years, working toward achieving a sustainable and robust presence on the Moon in the next decade. Technical studies identified that additional space research service spectrum is required to enable the implementation of advance wireless technologies for lunar surface direct communications between landers, rovers, extravehicular activity (EVA) astronauts conducting sortie missions and to return data from unique scientific experiments for relay back to Earth. Resolution **680 (WRC-23)** *resolves to invite the ITU Radiocommunication Sector to complete in time for the 2027 world radiocommunication conference 1* to *5* provide the specific framework and scope for which to meet the in-situ near-term scientific mission objectives.

Consistent with the November 2022 National Cislunar Science and Technology Strategy to advance the scientific, exploration, and economic development activities in Cislunar space, AI 1.15 (WRC-27), to obtain new (or modified) Space Research Service (SRS) allocations, aims to promote efficient, sustainable, and responsible applications of advanced wireless communications, navigation and scientific research techniques in the near-term Artemis Program missions, with global governmental, industry and academia participation.

The scientific discoveries and technological advancements resulting from the near-term space exploration objective is anticipated to further promote new industries and technologies and accelerate space commerce. Resolution **680 (WRC-23)** invites ITU-R to begin studies and provide a progress report through the

Director of the BR to WRC-27 regarding future radiocommunications needs for activities in the lunar vicinity beyond space research considering existing space radiocommunication services and regulatory provisions.

US VIEW:

The US supports new or modified SRS allocations for lunar surface and lunar orbit-to-surface applications, taking into account provisions to protect the unique environment of the Shielded Zone of the Moon for radioastronomical measurements ensuring compatibility with incumbent services in frequency bands where planned lunar SRS systems will operate.

Looking beyond the immediate scientific exploration objectives, the United States will contribute studies and inputs to guide the development of a report, on the future radiocommunications needs for activities in the lunar vicinity beyond space research per Resolution **680 (WRC-23)**, to support of the BR Director's progress report to the WRC-27. This progress report and its final outcomes are intended to inform technical and regulatory decisions at a future competent world radio conference beyond WRC-27.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.16: to consider studies on the technical and regulatory provisions necessary to protect radio astronomy operating in specific Radio Quiet Zones and, in frequency bands allocated to the radio astronomy service on a primary basis globally, from aggregate radio-frequency interference caused by non-geostationary-satellite orbit systems, in accordance with Resolution **681 (WRC-23)**;

ISSUE: Resolution **681 (WRC-23)** calls for studies in several categories, including 1) studies on impacts to radio astronomy service (RAS) systems from satellite systems in specific bands globally, with possible regulatory outcomes, 2) technical studies into more general impacts to RAS systems from satellite systems, including harmonics and aggregate effects, and 3) studies of impacts from satellite systems on nationally-defined radio quiet zones, specifically the Atacama Plateau in Chile and the area around the Square Kilometre Array Observatory in South Africa.

BACKGROUND: As the prevalence of both non-geostationary satellite (nGSO) networks and the number of satellites per network have increased, impacts to RAS systems have likewise become more acute. Where RAS observatories were previously able to largely avoid transmissions from satellites in GSO systems by waiting for the astronomical target of interest to move to another part of the sky away from the "Clarke" belt, doing so has become highly challenging due to new nGSO systems, band occupancy, increased numbers of satellites in nGSO systems, and the aggregation of signals that by themselves may not be problematic.

Some administrations, under national sovereignty principles, have created geographic zones set aside where spectrum-use regulations apply which are different than those applicable elsewhere. Such zones may be designed to allow research and development, scientific investigation (consistent with e.g. RR **29.6**) and other purposes. However, such zones typically cannot by themselves provide sufficient protection from satellite transmissions limited only by current PFD level specifications in the Radio Regulations. Some of these zones when in proximity to national borders may face additional challenges to provide sufficient protections from satellite transmissions.

Resolution **681 (WRC-23)** includes studies toward possible regulatory measures regarding unwanted emissions into defined radio astronomy bands, taking into account both single and multiple non-GSO satellite systems (*resolves to invite the ITU Radiocommunication Sector* 1 and 2), and studies regarding solutions to characterize and possible recognition of two specific radio quiet zones in South Africa and Chile, based upon the characteristics of those zones (*resolves to invite the ITU Radiocommunication Sector* 3-6). To that end and to complete the specified studies, both satellite system characteristics with regard to the bands stated in the Resolution, and satellite system characteristics relevant to the two specific radio quiet zones in question are needed.

The United States has an interest in the effective functioning of the radio quiet zone in Chile as it has invested hundreds of millions of dollars in the Atacama Large Millimeter/Submillimeter Array (ALMA) in the Atacama Desert of Chile. The United States is a global leader in satellite-radio astronomy coexistence, with regulatory coordination requirements which have led to voluntary technical solutions. The United States has longstanding experience with its National Radio Quiet Zone with practical solutions that may be relevant for the specific two radio quiet zones.

U.S. VIEW:

The United States supports the development of reports and appropriate studies under this agenda item, and provision within these reports of relevant data toward developing compatibility recommendations for enabling both successful RAS and satellite service missions. These studies should clearly and separately address (1) radio astronomy allocations which are applicable globally, (2) impact of harmonics or out of band emissions in aggregate, and (3) the two specific radio quiet zones over a broader frequency range relevant to the observatories operating in those zones.

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and
Information Administration
Washington, D.C. 20230

Ms. Nese Guendelsberger
Deputy Chief, Office of International Affairs
Federal Communications
Commission 45 L Street NE
Washington, DC 20554

Dear Ms. Guendelsberger:

The National Telecommunications and Information Administration (NTIA), on behalf of the Executive Branch agencies, provides the attached WRC-27 preliminary views for Agenda Items 1.17 addressing Space Weather, 1.18 addressing Protection of EESS and RAS above 76 GHz, and 1.19 addressing Primary EESS in 4 and 8 GHz.

NTIA looks forward to working with the FCC in reconciling these preliminary views for submission to CITEL PCC II as U.S. views. Our point of contact is Mr. Charles Glass, NTIA's WRC Coordinator, who can be reached at (202) 714-1763 or cglass@ntia.gov.

Sincerely,

Derek Khlopin
Deputy Associate Administrator
Office of Spectrum Management

Enclosures (3)

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.17: to consider regulatory provisions for receive-only space weather sensors and their protection in the Radio Regulations, taking into account the results of ITU Radiocommunication Sector studies, in accordance with Resolution **682 (WRC23)**;

ISSUE:

Space weather events can cause harm to important sectors of national economies, security and human welfare. As such, space weather data is important, and regulatory protection is needed for space weather observation systems, including receive-only sensors that measure low-level emissions from sources such as the Sun, the Earth's atmosphere and other celestial bodies. Resolution 675 (WRC-23) defines space weather and designates space weather sensors to the meteorological aids service. However, no frequency bands have been documented in any manner in the Radio Regulations for space weather sensor applications.

Resolution 682 (WRC-23) calls for studies on system characteristics, spectrum needs, and appropriate protection criteria for receive-only space weather sensors. Additionally, it calls for sharing and compatibility studies of receive-only sensors for potential new primary allocations to MetAids (space weather) in six specific frequency bands (27.5-28.0 MHz, 29.7-30.2 MHz, 32.2-32.6 MHz, 37.5-38.325 MHz, 73.0-74.6 MHz and 608-614 MHz) without claiming protection from, or constraining the future development of, incumbent services in these or adjacent frequency bands. Lastly, it calls for studies on possible regulatory provisions to accommodate the notifications of receive-only space weather sensor stations for inclusion in the Master International Frequency Register (MIFR), stipulating that no such notifications may be made until WRC-27 introduces the corresponding allocations in Article 5.

BACKGROUND:

The importance of space weather radiocommunication applications has been emphasized by several international bodies, including the World Meteorological Organization (WMO), the Intergovernmental Panel on Climate Change (IPCC), the United Nations Office for Disaster Risk Reduction (UNDRR), the International Civil Aviation Organization (ICAO), the United Nations Office for Outer Space Affairs (UNOOSA). Furthermore, Resolution 136 (Rev. Bucharest, 2022) of the Plenipotentiary Conference underscores the important role of telecommunications and information technologies in monitoring, early warning, prevention and mitigation of emergency and disaster situations.

In carrying out the studies under WRC-27 agenda item 1.17, it is important to recognize that while space weather data products are used for forecasts and warnings related to public safety, the provisions of No. 1.59 and 4.10 do not apply. Additionally, it is important to recognize that the current provisions of Article 11 do not allow an administration to notify a frequency assignment to a receive-only terrestrial radio station, except for certain types of station (see 11.2, 11.9 and 11.12). Therefore, the procedure for notifying receive-only MetAids (space weather) stations currently does not exist. Furthermore, some receive-only space weather sensors in operation utilize bands not currently allocated to the MetAids service, and some of these sensors need to continue their current operation. Lastly, the studies under this agenda item consider receive-only space weather sensors with the understanding that they will be deployed only at a limited number of specific locations and not in a ubiquitous manner.

Report ITU-R RS.2456 provides information on radio spectrum-reliant sensors and systems that are operating in support of space weather monitoring, prediction and warnings. Additionally, there are

ongoing efforts within ITU-R to determine the spectrum requirements and protection criteria of receive-only space weather sensors.

U.S. VIEW:

The United States finds that space weather phenomena pose a significant threat to ground-based and space-based critical infrastructure, modern technological systems, and humans working in space. The United States supports the consideration of regulatory provisions for receive-only space weather sensors and their protection in the Radio Regulations, taking into account the results of the studies under Resolution 682 (WRC-23).

The United States plans to participate actively in the studies on spectrum needs, system characteristics, and appropriate protection criteria, taking into account the definition of space weather and the designation of space weather sensors to MetAids (space weather) as provided in Resolution 675 (WRC-23). Additionally, the United States plans to participate actively in the studies on sharing and compatibility for potential new primary allocations to MetAids (space weather) in the six specified frequency bands, without claiming protection from or constraining the future development of incumbent services in the specified frequency bands or in adjacent bands. Furthermore, the United States plans to participate actively in the studies on possible regulatory provisions of the Radio Regulations to accommodate the notifications of receive-only space weather sensor stations for inclusion in the MIFR, while not allowing such notifications until WRC-27 introduces the corresponding allocations in Article 5.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.18: *to consider, based on the results of ITU Radiocommunication Sector studies, possible regulatory measures regarding the protection of the Earth exploration-satellite service (passive) and the radio astronomy service in certain frequency bands above 76 GHz from unwanted emissions of active services, in accordance with Resolution **712 (WRC-23)**;*

ISSUE: The Earth exploration satellite service (EESS) (passive) and radio astronomy service (RAS) are highly susceptible to unwanted emissions from active radio services operating in adjacent frequency bands. The current regulatory provisions and procedures may require review to ensure protection of the EESS (passive) and the RAS in certain frequency bands above 76 GHz from unwanted emissions of certain active services.

BACKGROUND:

Resolution **750 (Rev. WRC-19)** and Resolution **739 (Rev. WRC-19)** contain unwanted emission limits applied to the active services to ensure protection of the EESS (passive) and RAS, respectively.

Resolution **750 (Rev. WRC-19)** does not address the active services in frequency ranges above 76 GHz that are subject to study under agenda item 1.18. Active services are beginning system development and extensive global deployment in frequency bands above 76 GHz that are adjacent to EESS (passive) frequency bands subject to **No. 5.340**.

Likewise, Resolution **739 (Rev. WRC-19)** does not currently address unwanted satellite service pfd thresholds in the RAS bands above 76 GHz subject to study under agenda item 1.18. These bands are in significant use at radio astronomy facilities around the world and are of key importance for scientific investigation. As active satellite services deploy in bands above 76 GHz, the need to address the adjacent- and near-adjacent-band issues identified in Resolution **712 (WRC-23)** has become urgent.

U.S. VIEW:

Based on ITU-R study results, the US supports revision of Resolution **750 (Rev. WRC-19)** and **739 (Rev. WRC-19)** for the protection of certain RAS and EESS (passive) bands above 76 GHz.

UNITED STATES OF AMERICA

DRAFT PRELIMINARY VIEWS ON WRC-27

AGENDA ITEM 1.19: To consider possible primary allocations in all Regions to the Earth exploration-satellite service (passive) in the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz, in accordance with Resolution 674 (WRC-23).

ISSUE:

Resolution 674 (WRC-23) notes that, due to the sensitivity of the brightness temperature of the sea surface regarding frequency, it is appropriate to perform sea surface temperature (SST) measurements within the range of 4-9 GHz. Studies under WRC-27 AI 1.19 will examine a new primary allocation in all Regions to the EESS (passive) in the bands 4 200-4 400 MHz and 8 400-8 500 MHz, without in-band and adjacent band protection from existing services. The frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz complement existing SST measurements by EESS (passive) in the frequency band 6 425-7 250 MHz and may ensure the continuity of SST measurements.

BACKGROUND:

Under RR No. 5.458, passive microwave sensor measurements are carried out over the oceans in the frequency band 6 425-7 075 MHz, and passive microwave sensor measurements are carried out in the band 7 075-7 250 MHz. Additionally, the footnote states that administrations should consider the needs of the Earth exploration-satellite (passive) services in their future planning of the bands 6 425-7 075 MHz and 7 075-7 250 MHz.

The 6 – 7 GHz frequency band, which is currently the most sensitive in measuring SST in most temperature ranges, may be impacted. Future high-density deployments of communication systems may impact SST measurements presently performed in this range. The analysis is based on the Working Document towards a Preliminary Draft New Report ITU-R RS.[EESS(PASSIVE)6-7 GHz] (Annex 7 to Document 7C/41) and indicates that potential IMT deployments in this frequency range will severely impact SST measurement data between 6-7 GHz. The interference levels into the passive sensor exceeded the interference criteria defined in Recommendation ITU-R RS.2017 by 70-80 dB. Therefore, primary frequency allocations to EESS (passive) are necessary and urgent to ensure the continuity of SST measurements in the future. Resolution 674 (WRC-23) noted that frequency bands for future SST measurements include 4 200-4 400 MHz and 8 400-8 500 MHz.

The Working Document towards a Preliminary Draft New Report ITU-R RS.[SST Measurements], as contained in Annex 8 to Document 7C/41, is a pivotal resource in the studies under WRC-27 AI 1.19. It provides a structured approach to assess possible long-term solutions for obtaining SST measurements. The document considers the compatibility and sharing between potential EESS (passive) use in the bands 4 200-4 400 MHz and 8 400-8 500 MHz and services allocated to these bands on a primary basis. Its content and structure are meticulously designed to facilitate these studies and ensure a comprehensive and systematic approach to the issue, further enhancing the reliability of the proposed solutions.

The 4 200-4 400 MHz frequency band is allocated to the Aeronautical Mobile (Route) Service (AM(R)S) and Aeronautical Radionavigation Service (ARNS), specifically for the global operation of radio altimeters (i.e., Regions 1, 2, and 3). The adjacent frequency band, 3 700-4 200 MHz, has primary allocations to the Fixed service (FS) and Fixed Satellite Service (FSS) (space-to-Earth) globally. Regions 2 and 3 also allocate it to mobile services (except aeronautical mobile). The 4 400-4 500 MHz frequency band is allocated to the FS and Mobile service (MS), including both Aeronautical Mobile Service (AMS) and Maritime Mobile Service (MMS) for all three Regions. Recommendation ITU-R RS.1624 concludes

passive sensors can share the band 4 200-4 400 MHz with radio altimeters operating in the ARNS with no need for protection from the altimeters.

The 8 400-8 500 MHz frequency band is allocated for the FS, MS (except aeronautical mobile), and Space Research Service (SRS) (space-to-Earth) in all three Regions. The 8 250-8 400 MHz frequency band is allocated to EESS (space-to-Earth), FSS (Earth-to-space), FS, and MS in all three Regions. The upper adjacent band, 8 500-8 550 MHz, is allocated to the Radiolocation service in all three Regions.

U.S. VIEW:

The need for additional spectrum to complement current SST measurements is evident as the 6 425-7 250 MHz band is not allocated to EESS (passive). A primary EESS (passive) allocation would never cause harmful interference to other radiocommunications services, due to the absence of emissions from space stations operating in a passive service. Studies are required under WRC-27 AI 1.19 to determine whether the proposed EESS (passive) allocations are usable in the presence of the interference environment created by incumbent services given the fact that imposing any constraints on the use of the existing services between 4 200-4 400 MHz and 8 400-8 500 MHz, as well as in adjacent bands, is not permitted under Res. 674 (WRC-23). These primary frequency allocations will significantly enhance the continuity and accuracy of SST measurements, benefiting various sectors and industries that rely on this data, including global weather forecasts used to help optimize aviation and maritime safety and fuel consumption.